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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re Application of	:	Customer Number: 46320
	:	
Michel BETANCOURT	:	Confirmation Number: 5912
	:	
Application No.: 10/675,181	:	Group Art Unit: 2185
	:	
Filed: September 30, 2003	:	Examiner: Y. Campos
	:	
For:		AUTONOMIC MEMORY LEAK DETECTION AND REMEDIATION

**APPEAL BRIEF**

Mail Stop Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed October 24, 2006, wherein Appellants appeal from the Examiner's rejection of claims 1-4, 6-10, and 12-16.

**I. REAL PARTY IN INTEREST**

This application is assigned to IBM Corporation by assignment recorded on September 30, 2003, at Reel 014572, Frame 0915.

**II. RELATED APPEALS AND INTERFERENCES**

Appellants are unaware of any related appeals and interferences.

### **III. STATUS OF CLAIMS**

Claims 1-4, 6-10, and 12-16 are pending and finally rejected in this Application. Claims 5 and 11 have been cancelled. It is from the final rejection of claims 1-4, 6-10, and 12-16 that this Appeal is taken.

### **IV. STATUS OF AMENDMENTS**

The claims have not been amended subsequent to the imposition of the Second and Final Office Action dated July 24, 2006 (hereinafter the Second Office Action).

### **V. SUMMARY OF CLAIMED SUBJECT MATTER**

Referring to Figure 2 and to claim 1, an autonomic memory leak detection and remediation system is disclosed. The system includes an automatic garbage collector 300 and a tracing policy 310 (page 7, lines 13-15 of Appellants' disclosure). The autonomic garbage collector 300 is coupled to memory 320 configured to store object instances 330 which can be accessed by executing processes and which can be referenced by other object instances 330 in the memory 320 (pages 7, lines 10-20). The tracing policy 310 is coupled to the autonomic garbage collector 300, and the tracing policy 310 specifies an aging threshold 380 for a number of garbage collection passes during which an object instance 330 in the memory 320 is considered a loiterer when the object instance 330 had not been accessed by one of the executing processes (page 7, line 21 through page 8, line 6). The tracing policy 310 further comprises a listing of exempt classes 360 based upon which object instances 330 are exempted from being labeled loiterers (page 8, lines 7-15).

Referring to Figures 3A-3D and claims 6 and 13, a method for detecting and remediating a memory leak is disclosed. In blocks 305, 310 an aging value for an object instance created in memory is established (page 8, lines 18-20). In blocks 335, 340, 345 the aging value is reset when the object instance is referenced by an executing process (pages 9, lines 3-6). In block 350, the aging value is incremented during a garbage collection pass when the object instance had not been referenced by an executing process since a previous garbage collection pass (page 9, lines 6-10). In block 405, when the aging value exceeds a threshold value, the object instance is processed as a loiterer (page 10, lines 1-2).

Referring to Figures 3A-3D and to claim 10, an autonomic memory leak detection and remediation method is disclosed. In block 305, 310, a mark and sweep garbage collection process is modified to manage aging values associated with object instances created in memory (page 8, lines 18-20). In block 405, selected ones of the object instances having aging values which exceed a predetermined threshold are processed as loiterers (page 10, lines 1-2). In block 380, the selected ones of the object instances are processed if they do not belong to an exempt class (page 9, lines 16-19).

## **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

1. Claims 6, 8, 13, and 15 were rejected under 35 U.S.C. § 102 for anticipation based upon Menon et al., U.S. Patent No. 5,933,840 (hereinafter Menon);

2. Claims 1-4, 9-10, 12, and 16 were rejected under 35 U.S.C. § 103 for obviousness based upon Menon in view of Ozawa et al., U.S. Patent Publication No. 2001/0023478 (hereinafter Ozawa); and

3. Claims 7 and 14 were rejected under 35 U.S.C. § 103 for obviousness based upon Menon in view of Ozawa and further in view of Chakraborty, U.S. Patent Publication No. 2002/0165870 (hereinafter Chakraborty).

## **VII. ARGUMENT**

### **THE REJECTION OF CLAIMS 6, 8, 13, AND 15 UNDER 35 U.S.C. § 102 FOR ANTICIPATION BASED UPON MENON**

For convenience of the Honorable Board in addressing the rejections, claims 8, 13, and 15 stand or fall together with independent claim 6.

#### **Claims 6 and 13**

Independent claims 6 and 13 each recite the following limitation:

resetting said aging value when said object instance is referenced by an executing process.

In the first full paragraph on page 7 of the Amendment filed May 12, 2006, with regard to the above-identified limitation, Appellants argued the following:

On page 6 of the Office Action, the Examiner asserted that this limitation is disclosed in column 12, lines 15-21 and 34-45 of Menon. Applicants respectfully disagree. As noted above, a rejection under 35 U.S.C. § 102 requires the identical disclosure of each element. Although the Examiner refers to teachings of "age-queue buckets" within Menon, these teachings do not identically disclose the above-identified limitation. Therefore, Menon fails to identically disclose the claimed invention, as recited in claims 6 and 13, within the meaning of 35 U.S.C. § 102.

On page 15 of the Second Office Action, the Examiner responded to the above arguments as follows:

7. For example, the process performed for "age-queue buckets," as disclosed by Menon, ["age-queue buckets" wherein segments are grouped into "buckets where each bucket covers a range of utilization values" which "are organized as first in first out (FIFO) queues" (Column 12, lines 15-21). Menon also explains moving segments "to a different bucket as its utilization changes" and that whenever a segment "passes the age threshold, it is removed from the waiting list and enters the tail of the appropriate bucket determined by utilization" (Column 12, lines 34-45)] are interpreted as applicant's claimed "resetting said aging value when said object instance is referenced by an executing process." Menon specifically

describes a change in utilization of certain memory segments (which must occur by executing processes); and in response this change, moving segments to a different "age-queue bucket" which comprises a different age or aging value. Therefore, Menon discloses "resetting said aging value when said object instance is referenced by an executing process" as specified by the broadest interpretation possible of the claim language. (emphasis in original)

Appellants respectfully submit that the Examiner is inappropriately construing the age-queue buckets disclosed by Menon as being comparable to the claimed "resetting said aging value." For ease of reference column 12, lines 27-33 of Menon is reproduced below:

Thus, one bucket 402a will be designated for segments having utilization rates from zero to 0.1, the next bucket 402b will be designated for buckets with utilization rates greater than 0.1 and less or equal to 0.2, the next bucket will be for rates greater than 0.2 and less than 0.3, and so forth, to a bucket 402c for rates  $u$  where  $0.9 < \mu \leq 1$ .

As evident from this description of "queue buckets" by Menon, an "aging value," as claimed, is not taught. Instead, Menon employs utilization rates, which are not comparable to the claimed aging values. Moreover, Menon is completely silent as to an aging value being reset when an object instance is referenced by an executing process. Instead, as already described by the Examiner, segments are moved from one bucket to another as its utilization changes. Thus, the teachings of Menon are very different from the above-identified limitations.

Independent claims 6 and 13 further recite:

incrementing said aging value during a garbage collection pass when said object instance had not been referenced by an executing process since a previous garbage collection pass.

In the paragraph spanning pages 7 and 8 of the Amendment with regard to the above-identified limitation, Appellants argued the following:

On page 6 of the Office Action, the Examiner asserted that "Menon discloses an equivalent process." Whether or not Menon discloses an equivalent process is immaterial to a rejection under 35 U.S.C. § 102, which requires the identical disclosure of each element. A finding of equivalency does equate to a finding of anticipation. Moreover, a finding of equivalency is only

useful in obviousness rejections. In this regard, the Examiner is also referred to M.P.E.P. § 2144.06 and the paragraph entitled "ART RECOGNIZED EQUIVALENCE FOR THE SAME PURPOSE." Since the Examiner has failed to establish that Menon identically discloses the above-identified limitation, Menon further fails to identically disclose the claimed invention, as recited in claims 6 and 13, within the meaning of 35 U.S.C. § 102.

Although the Examiner addressed other arguments made by Appellants on pages 15-17 of the Second Office Action, the Examiner did not address the above argument. Instead, the Examiner rephrased the statement of the rejection to remove the term "equivalent" from the phrase "Menon discloses an equivalent process."

The Examiner's comments on page 3 of the Second Office Action with regard to this limitation are as follows:

[With respect to this limitation, Menon discloses a process wherein "the age of a segment is defined as the difference between the current value of the destage clock and the timestamp of the segment itself. Therefore, GC-filled segment initially has an age equal to the age of the youngest segment that contributed tracks to it" (Column 10, lines 28-32); therefore, the age of a "GC-filled" segments would be incremented as a "clock is incremented" because the age of this segment would comprise a current time minus the timestamp value of the youngest segment in a CC-filled segment] (emphasis omitted)

Absent from the Examiner's analysis or the teachings of Menon is a discussion of incrementing an aging value when the object instance has **not** been referenced by an executing process since a previous garbage collection pass. As best can be understood from the Examiner's analysis, Menon teaches that an age of a segment can be determined. This teaching, although somewhat related to the claimed invention, fails to teach many of the specific limitations recited in the above-identified limitation. Thus, Appellants maintain the argument that Menon fails to identically disclose the claimed invention, as recited in claims 6 and 13.

**THE REJECTION OF CLAIMS 1-4, 9-10, 12, AND 16 UNDER 35 U.S.C. § 103 FOR OBVIOUSNESS BASED UPON MENON IN VIEW OF OZAWA**

For convenience of the Honorable Board in addressing the rejections, claims 2-4, 10, and

12 stand or fall together with independent claim 1, and claims 9 and 16 stand or fall together with independent claim 6.

### Claim 1

As noted in the Amendment, independent claim 1 was amended to include the limitations previously presented in claim 5. Specifically, claim 1 is directed to the concept that exempt classes of object instances will not be labeled and/or treated as loiterers. On page 9 of the First Office Action, the Examiner referred to paragraph [0153] and asserted that "Ozawa discloses the concept of 'listing of exempt classes based upon which object instances are exempted from being labeled loiterers.'" Appellants disagree.

Ozawa does not teach exempt classes, given the ordinary meaning attributed to that term by one having ordinary skill in the art. The color fields taught by Ozawa do not describe exempt classes. Instead, the color fields are an indication of a particular status of a cell. For example, paragraph [0147] of Ozawa teaches:

A GC stack 135 stores a pointer pointing to a cell to be marked of all the cells in the mark phase process of a GC process. It is judged later without fail whether the cell pointed to by the pointer stored in this GC stack 135 should be marked. Such a cell is turned dark black in the on-the-fly GC or snapshot GC described earlier.

Since the cell can be "turned dark black in the on-the-fly GC" based upon whether the cell is judged to be marked, the color of the cells does not represent a "class" of object instances that are exempt.

The use of colors to mark a cell in a "mark and sweep type" garbage collection scheme is described in paragraphs [0014]-[0035] and Fig. 2 of Ozawa. As readily recognized by one



having ordinary skill in the art, the use of colors to mark the cells, as taught by Ozawa, is not comparable to the claimed exempt classes.

On pages 16 and 17 of the Second Office Action, the Examiner responded to the above arguments. Specifically, on page 16, the Examiner cited several passages of Ozawa, and on page 17, the Examiner asserted the following:

9. A class is a set, collection, group, or configuration containing members regarded as having certain attributes in common; a kind or category.

10. Therefore, Applicant should note that all memory cells marked in black in Ozawa comprise a listing/class/configuration of elements having an attribute in common; the color classification "black" and these cells/objects. Accordingly, all cells/objects classified with the black color will be exempt being collected during a garbage collection cycle. Therefore, based on the broadest interpretation of the claim language, Ozawa discloses a garbage collection tracing policy comprising "a listing of exempt classes based upon which object instances are exempted from being labeled loiterer"

At the outset, Appellants note that the Examiner has failed to establish that Ozawa teaches the claimed tracing policy, as recited in claim 1, includes the listing of exempt classes and that the exempt classes are within a listing. Instead, the Examiner completely glosses over the limitation that the tracing policy further includes the listing of exempt classes by just asserting that Ozawa discloses the concept of a listing of exempt classes without establishing a teaching that this listing is found within a tracing policy. Also, cells being marked in black does not constitute a "listing," given the ordinary and customary meaning of that term to one having ordinary skill in the art.

Appellants further note that the Examiner has manufactured a teaching of a "class" where no such teaching can be explicitly found in Ozawa. Instead, Ozawa teaches that the color fields are indication of a particular status of a cell, not whether that cell is within a particular class. Moreover, even if the teaching by Ozawa of cells marked by black could be considered a class,

Ozawa only teaches the single class. In contrast, the claimed invention recites "a listing of exempt classes" (i.e., a plurality of classes). Therefore, even based upon the Examiner's interpretation of the teachings of Ozawa, Ozawa fails to teach all of the limitations for which Ozawa is being relied upon.

#### Claim 10

Similar to claim 1, claim 10 was amended to include the limitation previously presented in claim 11, which introduce the concept that object instances belong to an exempt class are not processed as loiterers even though the object instances have aging values which exceed a predetermined value. In this regard, Appellants incorporate herein, for those arguments also applying to claim 10, the arguments previously presented above.

#### **THE REJECTION OF CLAIMS 7 AND 14 UNDER 35 U.S.C. § 103 FOR OBVIOUSNESS BASED UPON MENON IN VIEW OF OZAWA AND CHAKRABORTY**

For convenience of the Honorable Board in addressing the rejections, claims 7 and 14 stand or fall together with independent claim 6.

Claims 7 and 14 respectively depend from independent claims 6 and 13, and Appellants incorporate herein the arguments previously advanced in traversing the imposed rejection of claims 6 and 13 under 35 U.S.C. § 102 for anticipation based upon Menon. The Examiner's secondary reference of Chakraborty does not cure the argued deficiencies of Menon. Accordingly, the claimed invention would not result from the combination of Menon and Chakraborty. Appellants,

therefore, respectfully submit that the imposed rejection of claims 7 and 14 under 35 U.S.C. § 103 for obviousness based upon Menon in view of Chakraborty is not viable.

Conclusion

Based upon the foregoing, Appellants respectfully submit that the Examiner's rejections under 35 U.S.C. §§ 102, 103 based upon the applied prior art are not viable. Appellants, therefore, respectfully solicit the Honorable Board to reverse the Examiner's rejections under 35 U.S.C. §§ 102, 103.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due under 37 C.F.R. §§ 1.17, 41.20, and in connection with the filing of this paper, including extension of time fees, to Deposit Account 09-0461, and please credit any excess fees to such deposit account.

Date: December 26, 2006

Respectfully submitted,

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### **VIII. CLAIMS APPENDIX**

1. An autonomic memory leak detection and remediation system comprising:

an autonomic garbage collector coupled to memory configured to store object instances which can be accessed by executing processes and which can be referenced by other object instances in said memory;

a tracing policy coupled to said autonomic garbage collector, said tracing policy specifying an aging threshold for a number of garbage collection passes during which an object instance in said memory is considered a loiterer when said object instance had not been accessed by one of said executing processes, wherein

said tracing policy further comprises a listing of exempt classes based upon which object instances are exempted from being labeled loiterers.

2. The system of claim 1, wherein said memory is a heap managed through a virtual machine.

3. The system of claim 1, wherein said autonomic garbage collector comprises a mark and sweep garbage collector modified both to manage aging values associated with object instances in said memory and also to compare said aging values to said aging threshold to identify loiterers.

4. The system of claim 1, wherein said tracing policy further comprises a specification for at least one action to be undertaken upon detecting a loiterer.

6. A method for detecting and remediating a memory leak, the method comprising the steps of:

establishing an aging value for an object instance created in memory;

resetting said aging value when said object instance is referenced by an executing process;

incrementing said aging value during a garbage collection pass when said object instance had not been referenced by an executing process since a previous garbage collection pass; and,

when said aging value exceeds a threshold value, processing said object instance as a loiterer.

7. The method of claim 6, wherein said establishing step further comprises the steps of:

locating equivalent object instances in said memory; and,

processing said equivalent object instances in said memory as loiterers.

8. The method of claim 6, wherein said processing step comprises at least one of clearing at least one cache in memory, and reporting said object instance as a loiterer in a log file.

9. The method of claim 6, further comprising the step of foregoing said processing step where said object instance belongs to a specified exempt class.

10. An autonomic memory leak detection and remediation method comprising the steps of:

modifying a mark and sweep garbage collection process to manage aging values associated with object instances created in memory; and,

processing as loiterers selected ones of said object instances having aging values which exceed a predetermined threshold, wherein

said processing step comprises the step of processing as loiterers selected ones of said object instances not belonging to an exempt class where said selected ones of said object instances have aging values which exceed a predetermined threshold.

12. The method of claim 10, wherein said processing step comprises clearing at least one cache in memory, and reporting said object instance as a loiterer in a log file.

13. A machine readable storage having stored thereon a computer program for detecting and remediating a memory leak, the computer program comprising a routine set of instructions for causing the machine to perform the steps of:

establishing an aging value for an object instance created in memory;

resetting said aging value when said object instance is referenced by an executing process;

incrementing said aging value during a garbage collection pass when said object instance had not been referenced by an executing process since a previous garbage collection pass; and,

when said aging value exceeds a threshold value, processing said object instance as a loiterer.

14. The machine readable storage of claim 13, wherein said establishing step further comprises the steps of:

locating equivalent object instances in said memory; and,  
processing said equivalent object instances in said memory as loiterers.

15. The machine readable storage of claim 13, wherein said processing step comprises clearing at least one cache in memory, and reporting said object instance as a loiterer in a log file.

16. The machine readable storage of claim 13, further comprising the step of foregoing said processing step where said object instance belongs to a specified exempt class.

**IX. EVIDENCE APPENDIX**

No evidence submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 of this title or of any other evidence entered by the Examiner has been relied upon by Appellants in this Appeal, and thus no evidence is attached hereto.



**X. RELATED PROCEEDINGS APPENDIX**

Since Appellants are unaware of any related appeals and interferences, no decision rendered by a court or the Board is attached hereto.